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CERTIFICATE

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Type of Invention : Patent

Title of Invention : METHOD FOR PROVIDING MULTI-LEVEL ACCESS SERVICS IN COMMON ACCES CHANNEL

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Method for Providing Multi-level Access Services in Common Access Channel

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a wireless communication system, especially to a method for providing access network services in a common access channel.

2. Description of the Related Art

In the wireless communication system, it is permitted to change the information between multiple user stations and the system. To support the multiple user stations to access the system randomly, the communication system will provide one or more reverse (from the user station to the base station) common access channels. When a user station tries to access the system, it will initiate an access request in the selected reverse common access channel. The base station can obtain an accessing request information from a terminal by detecting the reverse common access channel.

In the wireless communication system, since an access environment provided by the reverse common access channel for the user station is shared medium, it is necessary to adopt a proper random access method to reduce or avoid the collisions between the access requests of different user stations. Random access methods are divided into two types according to whether detecting the channel before packet sending: one is without channel detection before packet sending, e.g. ALOHA and slotted ALOHA etc., typically. As it hasn't detected whether there is an access request

from other user stations before packet sending, the mechanism of ALOHA can't avoid the collisions between the access requests from different user stations. In the ALOHA mechanism, when the user station judges that there is collision encountering the access requests, it will re-initiate the access request after a certain backoff duration, and the backoff time is calculated by a backoff algorithm. As the ALOHA mechanism is simple in design, the control messages required by the system are less, but this method cannot avoid collisions between the access requests from different user stations. In general, the ALOHA mechanism is suitable to those system environments with light traffic. The other type of random access methods require to detect the channel before packet sending, e.g. Carrier Sense Multiple Access (CSMA) etc. typically. Compared with the ALOHA mechanism, the CSMA protocol stack needs to detect the channel before packet sending, so that the CSMA protocol can avoid collisions more probably than the ALOHA, and thus can provide more traffic. But this requires the system to provide control mechanisms such as channel detection, which will increase the complexity of the design method.

As a well-known random access protocol in the communication network, the ALOHA protocol is originally designed by some researchers in Hawaii University to interconnect multiple wireless packet terminals. The advantage of ALOHA and its variants such as slotted ALOHA protocol consists in simplicity in design, which needs less system control information and is proper for the system environments with light traffic.

The ALOHA protocol has been widely deployed in the wireless communication system. For example, a wireless broadband access system IEEE802.16a working at a frequency band from 2 to 11 GHz, the main purpose for the IEEE802.16a specification designed is

to support broadband access of a fixed user. In the IEEE802.16a specification, three kinds of working modes are supported, i.e. single carrier, orthogonal frequency division multiplexing (OFDM) and orthogonal frequency division multiple access (OFDMA). In single carrier and OFDM modes, the user station will initiate an access request in the reverse access channel by using request messages of medium access control (MAC) layer, while in the OFDMA working mode, the user station will rely on the pseudo-random codes information to accomplish the access request.

In the IEEE802.16a specification, when the user station needs to access the network, the user station will perform the network login standard in the IEEE802.16a specification. The network login standard in the IEEE802.16a specification needs the coordination between the user station and the base station to accomplish it cooperatively. The network login standard in the IEEE802.16a specification includes: the user station accomplishes the synchronization with the base station and obtains the information on the forward and reverse (from the user station to the base station) channel allocation from the forward (from the base station to the user station) control channel. The user station coordinates with the network to accomplish the initial access process. The user station negotiates with the network about the service capability to obtain such information as system serving capability, Authentication and registration steps of the user station. And establishes session connections and performs other operations, etc. During the initial access process in the network login standard, the mechanism similar with the ALOHA is provided for the random access of the user station, and when the user station finds that the access request hasn't been correctly received by the base station due to collisions, it will deploy the backoff

algorithm to calculate and backoff for a period of time in the same backoff domain and then re-initiates the access request. Here, allocation information of the backoff interval will be notified periodically by the system to the user stations in the common control channel. In the view of statistics, the design target for this kind of backoff interval allocation and backoff algorithm is to support making all users access to the system impartially.

IEEE802.16e is an extension mode of the IEEE802.16a, and the design target of the IEEE802.16e is to extend the IEEE802.16a to support the user's mobility based on the IEEE802.16a specification on the basis of supporting the fixed access of the user. In a multi-cell mobile communication system, the mobility of the user inevitably brings about the problem of handoff, that is, how to maintain the continuity of sessions when the mobile user spans across the multiple cells, and this problem can be solved by the hard-handoff method. During the hard-handoff procedure, the user station will first break down the connection with an original base station and then establishes an association with the selected new base station within the certain period of time, and so as to access the network system again and obtain services of the system.

In the IEEE802.16e, the hard-handoff procedure can be realized by initiating the access request from the user station to the selected new base station. In order to keep the compatibility with the IEEE802.16a, this kind of network access procedure can be accomplished based on the network login process of the IEEE802.16a: the user station completes the synchronization with a base station and obtains the information on the forward and reverse channel allocation by searching the forward control channel. The user station coordinates with the selected new base station to accomplish the access of the user station; executes the partial

authentication and registration steps of the user station, and re-establishes the session connection and other operations, etc.

Compared with the initial access of the user station, the network access procedure needed during the handoff has following differences: the target of the handoff is to maintain the continuity of session, which generally requires the access service of the user station be completed within a short period of time, While the target of the initial access of the user station is to make the user station access the network initially. Thus, the maximum access delay that user station can tolerate for the handoff is far shorter than that for the initial access of the user station. That is, compared with the initial access request of an ordinary user station, the handoff needs faster network access. While in the IEEE802.16a, from the point of view of the service provided for the access request of the user station, the design target is to support the users to access the system impartially, i.e. providing the same access performance for all access users. Therefore, if the existing access service method of the IEEE802.16a is used in the common access (sub)channel, it will result in large amount of collisions between the access request of the handoff and that for other access types, and then increase the access time for the handoff, which is hard to meet with the requirements of the fast access required by the handoff. In order to using the network login standard in the IEEE802.16a to accomplish various kinds of access service requirements including fast access etc. required by the handoff, a feasible scheme is that the system provides dedicated access (sub)channel for the access requests of the handoff, but it will waste network resources such as bandwidth.

Also, the network login standard required by the handoff has following differences: before the handoff occurs, the user station has established the connection with the original base station, i.e. the user station has obtained the system information such as system time and relevant service capabilities of the system. In order to improve the handoff efficiency, the network login standard required by the handoff can neglect or skip that defined in the IEEE802.16a. In order to simplify a certain network access steps for the handoff and provide a fast access service required by the handoff, it is necessary to provide a method for the system to identify the access request information when the handoff happens.

SUMMARY OF THE INVENTION

The object of this invention is to provide a method for supporting multi-level access services and identifying a network access request during a handoff in the system using a common access (sub)channel to accomplish an access request service. The method can be conveniently adopted by the IEEE802.16e specification to meet with the requirements of the fast network access required by the handoff by using the common access (sub) channel.

To realize above object, a method for providing multi-level access services in a common access channel comprising steps of:

announcing following information by a base station in a wireless network system to cells corresponding to the base station periodically or on-demand through a forward common control channel: (a) common access (sub)channel allocation information, and (b) division information of at least two backoff domains in at least one common access (sub)channel;

sending an access request response message which carry a unique connection identification CID assigned by the system to an access request to a user station after receiving a access request message from the user station correctly and confirming that it can provide a corresponding access service for the user station; and

(a) selecting a corresponding backoff domain according to an access type, and (b) calculating a time for re-initiating the access request by using a backoff algorithm in the corresponding backoff domain if it initiates the access request in the selected common access (sub)channel after the user station in the wireless network system correctly receives the information on the common access (sub)channel allocation announced by a serving cell and the division information for at least two backoff domains of at least one common access channel.

Based on the ALOHA or slotted ALOHA access mechanism, it proposes a method for supporting multiple types of access services by using the common access (sub)channel, the system announces users the common access (sub)channel and the allocation information of the multiple backoff domain corresponding each access (sub)channel periodically or on-demand; to avoid collisions between the access requests, the user station can select the backoff domain according to the access type, calculate and determine the time for re-initiating the access request from the corresponding backoff domain. This method can at least provide two-level access services and reduce the collisions between the access requests of different access types, and at the same time, compared with the method that provides different common access (sub)channels for different access types, this method can save network resources such as bandwidth. This method proposes a scheme for identifying the network access request for the handoff for

the system that using the common access (sub)channel to accomplish the multiple access request services. When the user station initiates the access request to the base station, the network access request message for the handoff can be obtained by using dedicated access request message, or adding a field that indicates the handoff request type to an original access request message RNG-REQ, or be realized with the aid of dedicated pseudo-random codes, etc. With the methods, the system can be facilitated to identify the network access request for the hard-handoff at the same time of providing the user station with the access service, which can simplify the network login standard required by the handoff processing and meet with the service requirements of the fast access required by the hard-handoff. It further explains the method for identifying the access request for the handoff with the pseudo-random codes by taking the OFDMA mode in the IEEE802.16e specification as an example: generation equation of searching code for the OFDMA mode of the IEEE802.16e will output a long code, and the pseudo-random codes used for identification will be generated by punctuating the outputted long code. The generation method for this type of pseudo-random codes is easy to be compatible with the IEEE802.16a specification and can facilitate the system design, the allocation method of the pseudo-random codes that identify the hard-handoff will facilitate the system to identify the access request type of the user for the hard-handoff.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an illustration for the forward and reverse channel;

Figure 2a is an illustration 1 for frame control information and channel mapping for TDD mode;

Figure 2b is an illustration 2 for the frame control information and channel mapping for TDD mode;

Figure 3a is an illustration 1 for the frame control information and channel mapping for FDD mode;

Figure 3b is an illustration 2 for the frame control information and channel mapping for FDD mode;

Figure 4.1 is a diagram showing the uplink access channel mapping (UL-RACH-MAP) format 1 that provides multiple backoff domains;

Figure 4.2 is a diagram showing the uplink access channel mapping (UL-RACH-MAP) format 2 that provides multiple backoff domains;

Figure 5 is a diagram showing the format of an access request message RNG-REQ-HO used for the handoff;

Figure 6a is a diagram showing the access searching process when the hard-handoff happens;

Figure 6b is a diagram showing the access searching process when the hard-handoff happens for the OFDMA mode; and

Figure 7 is a flowchart showing the access request of the user station.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention provides the method for supporting multi-level access services and identifying the network access request for the handoff in the system that using the common access

(sub)channel to accomplish the access request services. These methods can be conveniently adopted by the IEEE802.16e specification to meet with the requirements of the fast network access required by the handoff by using the common access (sub) channel.

1. Channel division and parameter information on access (sub)channel

1. 1 Allocation of the forward and reverse channel

In the wireless communication system such as the broadband wireless access system defined by the IEEE802.16a specification, the interaction information between the user station and the base station will be transmitted in multiple logic channels. According to the transmission direction of the data information, these logic channels can be divided into forward channels from the base station to the user station and reverse channels from the user station to the base station. As shown in Figure 1, the forward channel between the base station 11 and the user station 12 includes a forward pilot channel (F-PCH), a forward common control channel (F-CCH) and a forward traffic channel (F-TrCH), etc. Here, the forward pilot channel (F-PCH) is used to realize the synchronization between the user station 12 and the base station 11. The forward common control channel (F-CCH) is used to deliver network parameters and common control information from the base station 11 to the user station 12, in which, the common control information can include channel allocation information of the reverse and forward channels, etc. and the forward traffic channel (F-TrCH) is used to deliver forward traffic information from the base station 11 to the user station 12. The reverse channel between the base station 11 and the user station 12 includes a reverse

access channel (R-ACH) and a reverse traffic channel (R-TrCH), etc. Here, the reverse access channel (R-ACH) is used to the access service of the user station, and the reverse traffic channel (R-TrCH) is used to deliver the reverse traffic information to the base station by the user station.

In the wireless environment, when the user station tries to access the system, it must firstly complete the synchronization with the downlink (from the base station to the user station) of the base station, which can be accomplished by capturing and tracing the information of the forward pilot channel (F-PCH). The user station also needs to obtain the network parameters and common control information from the forward common control channel, and the common control information includes the channel allocation information of the reverse and forward channels as well as the parameter information on each channel, etc. With the information, the user station can initiate the access request in the selected reverse access channel (R-ACH). From the view of time domain, the downlink transmission signal and uplink transmission signal will be transmitted in the format of frames. Figure 2a and Figure 2b show the illustration of the frame control information and channel mapping for time division duplex (TDD) mode. For the TDD mode, frame control information 22 is sent from the base station 11 to the user station 12 through the F-CCH channel, which includes mapping information of the uplink channel (UL-MAP) and mapping information of the downlink channel (DL-MAP). Here, the DL-MAP information reflects the allocation situation of the downlink sub-frame 24 in the same frame in the downlink channel, as shown in Figure 2a and Figure 2b. And the UL-MAP information reflects the allocation situation of the uplink sub-frame 26 in the uplink channel. From that the base station sends out the UL-MAP

information to that the user station identifies the allocation information of the uplink sub-frame 26 in the uplink channel, a certain period of time is needed by the system for processing, which is at least longer than twice the maximum transmission delay of the signal from the base station to the user station. In Figure 2a, the UL-MAP information in a certain frame embodies the allocation situation of the next frame in the uplink channel. While in Figure 2b, the UL-MAP information of a certain frame embodies the allocation situation of the same frame after a period of time in the uplink channel.

Figure 3a and 3b show the frame control information and channel mapping for frequency division duplex (FDD) mode. Similar to the TDD mode, frame control information 32 can also be sent from the base station 11 to the user station 12 through the F-CCH channel for the FDD mode. The frame control information includes mapping information of the uplink channel (UL-MAP) and mapping information of the downlink channel (DL-MAP). The DL-MAP information will reflect the allocation situation of the downlink sub-frame 34 in the downlink channel, while the UL-MAP information will reflect the allocation situation of the uplink sub-frame 36 in the uplink channel. In Figure 3a, the UL-MAP information in a certain frame will embody the allocation situation of the next frame in the uplink channel. While in Figure 3b, the UL-MAP information of this frame embodies the allocation situation of the same frame after a period of time in the uplink channel. With the aid of the UL-MAP or the other downlink broadcast information, the base station can deliver the parameter information on one or more (sub)channels designated for the access request to the user station.

1.2 Allocation of multiple backoff domains in the access (sub)channel

It is required in the invention that the system should announce the user station not only the division of the common access (sub)channels, but also the information of the multiple backoff domains corresponding to each access (sub)channel. Figures 4.1 and 4.2 show two of the mapping formats 400 (UL-RACH-MAP) of the multiple access (sub)channels and the multiple backoff domains corresponding to each access (sub)channel respectively. The UL-RACH-MAP is the part that describes the relevant parameters of the access channel in the UL-MAP or the other downlink broadcast information. UL-RACH-MAP format 400 indicates the situation of N (N=1) uplink access (sub)channels and M (M=1) backoff domains corresponding to each uplink access (sub)channel.

In Figure 4.1, the parameters corresponding to each uplink access (sub)channel at least include an uplink channel identification (UpLink Channel ID), Backoff Value Start and Backoff Value End of M backoff domains. Here, the parameters corresponding to the uplink (reverse) access sub-channel with identifier of 1 include uplink channel identifier UpLink Channel ID 1 (4102), as well as parameters identifying M backoff domains. The parameters of M backoff domains are indicated as follows: from the parameter identifying the first backoff domain, the succeeding values are Backoff Value Start 1 (4104) and Backoff Value End 1 (4106) of the first backoff domain, till those for the Mth backoff domain, i.e. Backoff Value Start M (4108) and Backoff Value End M (4110) of the Mth backoff domain, sequentially. The UL-RACH-MAP format 400 also needs to reflect the parameter allocation situation of the other N-1 access (sub)channels. The parameter allocation style of each access (sub)channel is similar with that

of the access (sub)channel with identifier of 1. For example, for the access (sub)channel with number of N, it includes the identifier (4112) UpLink Channel ID N of the Nth access (sub)channel and the other parameter fields from 4114 to 4120 of M backoff domains.

In Figure 4.2, the parameter corresponding to each uplink access (sub)channel at least includes an uplink channel identifier UpLink Channel ID as well as Backoff Value Start 1 of the first backoff domain and Backoff Value End of all backoff domains corresponding to each uplink access channel identifier. Here, the parameters corresponding to the uplink (reverse) access sub-channel with identifier of 1 include uplink channel identifier (UpLink Channel ID 1)(4202), as well as parameters identifying M backoff domains. The parameters of M backoff domains are indicated as follows: from the parameter identifying the first backoff domain, the succeeding values are Backoff Value Start 1 (4204) and Backoff Value End 1 (4206) of the first backoff domain respectlively. The initial value of the second backoff domain can be obtained from the Backoff Value End 1 of the first backoff domain, thus starting from the second backoff domain, only the end value of the backoff domain needs to be declared, i.e. from the Backoff Value End 2 (4208) of the second backoff domain till the Backoff Value End M (4210) of the Mth backoff domain. The allocation style for parameters of the other N-1 access (sub)channels in the UL-RACH-MAP format 400 is similar with that for the access (sub)channel with identifier 1. For example, the access (sub)channel with the number of N includes an identifier (4212) UpLink Channel ID N of the Nth access (sub)channel and parameter fields from 4214 to 4220 about M backoff domains.

2. Provide the backoff algorithm for the multi-level access services

The multi-level backoff algorithm is used to provide multi-level access performance in the common access (sub) channel. The multi-level backoff algorithm combines with the backoff algorithm in traditional ALOHA mechanism. That is, it selects the backoff domain according to the access type, and selects the backoff value in the selected domain by combining with the backoff algorithm of the traditional ALOHA mechanism. In the traditional ALOHA mechanism, exponential backoff algorithm is usually adopted, for example the access algorithm used in the IEEE802.16a.

In the following, the multi-level backoff algorithm will be described with the example of two level backoff domain, that is, M equals to 2. By detecting the forward common control channel (F-CCH), the user station 12 will obtain the allocation of the two level backoff domain of the relevant reverse access (sub) channel (R-ACH) and the corresponding each access (sub) channel. That is, in the UL-RACH-MAP format 400 , corresponding to a certain access (sub) channel, two backoff domains [0, β]and [β+1, γ] of M with the value of 2 are defined, wherein γ (γ>β) and β are both positive integers. This access (sub) channel will privide two types of access request service including fast access and common access. Using a binary exponential backoff algorithm, two selecting domain $[0, 2^{\beta}]$ and $[2^{\beta}+1, 2^{\gamma}]$ are provided. When the user station needs the common access, it will randomly select a number from the second backoff domain $[2^{\beta}+1, 2^{\gamma}]$ as the backoff time, while the user station needs the fast access service, it will randomly select a number from the first backoff domain $[0, 2^{\beta}]$ as the backoff

time. The selection of the values of γ and β is determined depending on the service performance and the number of users. In which, the selection of β should satisfy the relevant performance requirements of the fast access service, for example, the parameters of the acceptant access time, the collision rate and so on. The selection of γ should take into account the parameters of the acceptant access time of the common access service, the collision rate between the common access request and the fast access request and so on. From the view of statistics, the fast access service is guaranteed to have shorter access service time than the common access service. The proposed the multi-level backoff algorithm is easy to be extended to the situation where M is larger than 2. Compared with the conventional exponential backoff algorithm, the advantages of the multi-level backoff algorithm are that it is easy to isolate the access requests of different types access, alleviate the collisions of the access requests between different types and provide at least two level access services in the common access (sub) channel by the division of the backoff domain, moreover, compared with the method for providing different common access (sub) channel for the access requests of different types, this method can save bandwidth and other network resources. This method can be easily deployed in the IEEE802.16e to satisfy the requirements of providing the fast access for the hard handoff by using the common access (sub) channel.

3. Method for providing multi-level access services and identifying network access request for the handoff in the common access (sub) channel

The user station can obtain the information on the multiple backoff domains of uplink access (sub) channels and the corresponding each of access channels for example by detecting the UL-MAP and other uplink broadcast information. In order to utilize the common access (sub) channel to access the communication system and obtain services, the user station can initiate the access request to the selected base station in the common access (sub) channel. During the period of providing multi-level access service by the common access (sub) channel, the communication system needs to cooperate with the user station, so that the communication system can identify the access request of the user station and provide corresponding services effectively. In the following, the method for providing multi-level the access service in the common access (sub) channel will be described with the example of the IEEE802.16e. The multi-level services include the processing of the handoff and the common initial access request. With regard to the common initial access request, the access request for handoff can obtain the simplified network login service.

3.1 User station detects the uplink broadcast message

In order to provide the multi-level access service in the common access (sub) channel, the base station will broadcast the information on channel allocation to the corresponding cells periodically or on-demand, which may include the allocation information of the uplink channel (UL-MAP) and the mapping information of the multiple backoff domain of the corresponding access (sub) channel (UL-RACH-MAP) . After the user station completes the synchronization with the downlink (from the base station to the user station) of the base station, it can obtain

the parameter information on the uplink access (sub) channel by detecting the UL-MAP and the other downlink broadcast information.

3.2 User station initiates the access request

The user station can initiate the access request to the selected base station in the selected uplink access (sub) channel. In order to provide different types of access services including initial access and handoff in the common access (sub) channel, and to be compatible with the IEEE802.16a easily, the user station will adopt the above mentioned multi-level backoff algorithm, calculate and determine the backoff time in the selected backoff domain. This method is used to alleviate the collisions of different types of access requests easily and provide at least two level access services.

In order to be convenient for the system to identify the access request message for the handoff of the user station in the common access (sub) channel, and so as to provide different access services for different types of the access requests, with the example of the IEEE802.16e specification, the initial access of the original user station can continuously use the access request message of the IEEE802.16a, i.e. RNG-REQ, while the message of the access request types for the handoff can be the access request message containing the field of the handoff request identification, the original access request message RNG-REQ added the field of the handoff request identification, or realized in manner of using the information of the dedicated pseudo-random codes.

3.3 Format of the access request message

3.3.1 Access request message of MAC layer

The access request message for the handoff can be the access request message containing the field identifying the handoff request, or be the original access request message RNG-REQ added the field identifying the handoff request. For the single carrier or OFDM mode in the IEEE802.16e, the access request for the handoff can use the dedicated access request message. Figure 5 shows the format of the dedicated access request message 500 for the handoff (RNG-REQ-HO), which at least contains the field of the identifier 502 of the adopted uplink access (sub) channel i and the identification 504 of the handoff request access type (HO_Access_Type). The access request message for the handoff can be realized by adding the identification 504 of the handoff request type (HO_Access_Type) to the original access request message RNG-REQ.

3.3.2 Access request for the handoff based on pseudo-random codes

In the common access (sub) channel, the user station can initiate the network access request message for the handoff by the pseudo-random codes.

(1) Generation of the pseudo-random codes

The OFDMA mode specified in the IEEE802.16a has defined three types of pseudo-random codes used by user stations to request network service for initial search, periodical search and bandwidth request respectively. The three kinds of pseudo-random codes are all generated from the same polynomial expression $1+X^1+X^4+X^7+X^{15}$, and the output of which forms a long code.

The pseudo-random codes used in the above three kinds of situations, initial search, periodical search and bandwidth request, are intercepted from the long code, but the generation clocks are different. In the case of default, the length of each pseudo-random code is 106 bit.

In order to facilitate the system to identify the network access request for the hard handoff in the OFDMA mode of the IEEE802.16e so as to simplify the network login rules required by the system to deal with the hard handoff, the access request message for the hard handoff identified by the pseudo-random codes can be adopted. To be compatible with the IEEE802.16a and be convenient for system design, the generation of the H pseudo-random codes required by the access request for the handoff, is intercepted from the long code, but the selection of the clock can be different from the above three kinds of pseudo-random codes. An example of generating the H pseudo-random codes required by the access request for the handoff is explained as follows: intercept the long code formed by the output of the polynomial expression, in which, the first N codes are used for the initial search, and the clock is selected from 0 to 106*N-1. The following M codes are used for periodical search, and the clock is selected from 106*N to 106*(N+M)-1, the next L codes are used for bandwidth request, and the clock is selected from 106*(N+M) to 106*(N+M+L)-1, and the next H codes are used for access request for hard handoff, and the clock is selected from 106*(N+M+L) to 106*(N+M+L+H)-1. In the above embodiment, the purpose of the four subsets can be exchanged. For example, the first N codes can be used for the access request of the hard handoff, the following M codes are for initial search, then the L codes are for periodical search and the last H codes

are for bandwidth request. According to this, there are several kinds of arrangement manners.

(2) Allocation of the pseudo-random codes

In order to make the system identify the access request of the hard handoff, the H pseudo-random codes generated by the system can be allocated to each cell fixedly, and the generation manner of the H pseudo-random codes is described as above. In each cell, when a certain user station has hard handoff, it will randomly use the pseudo-random codes allocated to the cell which the new selected base station locates for the fast access service. This allocation method is simple and the interaction message between the system and the user station is little. But the flexibility is poor and not suitable for the uneven allocation between users.

The system can dynamically allocate the H pseudo-random codes to each cell according to their demands. Each cell periodically or on-demand sends the identifier or other sign information of the pseudo-random codes allocated to itself in the forward common control channel, and by detecting the common control channel, the user station may obtain the information of the pseudo-random codes allocated to the cell which the new selected base station locates. The advantages of this method are that it is suitable for the uneven allocation between users, for example, the system can allocate more pseudo-random codes to the cell that has large handoff traffic to meet the requirement of handoff service. But the disadvantages are that the system should send the allocation information of the pseudo-random codes periodically or on-demand.

3.4 Response message of the access request of MAC layer

After correctly receiving the access request of the user station, the base station will allocate the unique connection identifier CID for this access request. The base station will process the access request of the user station through the handshake method. That is, after correctly receiving the access request message RNG-REQ or RNG-REQ-HO of the user station, and if the base station confirms that the system can provide the continuous service for the access request initiated by the user station, the base station will send an access request response message RNG-RSP to the user station, which contains the information of the unique connection identification CID allocated for this access request.

Embodiments

In the IEEE802.16e, when the hard handoff occurs, the user station can initiate the request to access the selected new base station. In order to compatible with the IEEE802.16a, the access procedure of the user station can be completed based on the network login procedure of the IEEE802.16a. Compared with the network login procedure of the IEEE802.16a, the network login procedure of the user station for the hard handoff can simplify the information exchange process including the time and the relevant service capability of the system. The access procedure of the user station includes: searches forward control channel, the user station completes the synchronization with the base station and obtains the information on the forward and reverse channel allocation, the user station coordinates with the new selected base station to accomplish the access of the user station and performs the partial authentication and registration steps of the user station and re-establishes the session connection and other operations, etc.

1. Search and access procedure including the occurrence of the handoff

Figure 6a shows the access search procedure proposed in the invention including the occurrence of the hard handoff in the IEEE802.16e, and the procedure is easy to compatible with the initial search and access procedure in the IEEE802.16a. At time t0, the base station 11 broadcasts the UL-MAP message in this cell with the common control channel periodically or on-demand. At time t1, a certain user station in the cell receives the UL-MAP message, which contains the relevant parameters describing the access channel UL-RACH-MAP, shown as Figure 4. In this embodiment, M equals to 2. This user station will select the access (sub) channel, and at time t2, the user station initiates the access request RNG-REQ or RNG-REQ-HO to the base station at the selected access (sub) channel and suppose that the base station should receive the access request message at time t3, but the collisions of the access request messages from the several user stations at this time cause the loss of the access request message from this user station. If the user station does not receive the access request response message for this access request from the base station after waiting for some period of time correctly, it determines that the this access request fails, and the user station selects the corresponding backoff domain according to the access service, it can choose the first backoff domain for the handoff , choose the second backoff domain for the common access request, and each of the user stations can calculate the backoff time t4-t2 with the multi-level backoff algorithm. Suppose the user station initiate the access request message RNG-REQ or RNG-REQ-HO at time t4. At time t5, the base station correctly receives the access

request message RNG-REQ or RNG-REQ-HO of the user station, it will allocate the identifier for this access request and send the access response message (RNG-RSP) at time t6, the response message contains some identification information for this user station including some signs for the response. If the user station correctly receives the response message RNG-RSP from the base station, it will re-send the access request message RNG-REQ or RNG-REQ-HO at time t7, which carries the identifier allocated by the base station for this access request to make the base station confirm that the user station has correctly received the relevant information sent by the base station. At time t9, the base station receives the access request message RNG-REQ or RNG-REQ-HO of the user station, and it confirms that the user station has received the response correctly, the system will continue the following steps.

The Figure 6b shows the access procedure supporting the occurrence of the hard handoff proposed by the invention, especially for the OFDMA mode in the IEEE802.16. Compared with Figure 6a, the main difference is that it completes the access request in virtue of the pseudo-random codes for searching. In order to facilitate the system to identify the access request of the hard handoff in the common access channel so as to simplify the network login rules when hard handoff occurs, the user station will select the dedicated pseudo-random code to complete the access request in the common access (sub) channel when the handoff takes place, and the generation method of these pseudo-random codes and the allocation methods in each cell are described above.

2. Flow chart implemented by the user station during the access search

The flow chart implemented by the user station during the access search is shown in Figure 7. The user station obtains the broadcast message sent by the base station periodically by detecting the common control channel (Step 702), and if the user station has not received these broadcast messages during T1 time (Step 704), there is something wrong and it restarts (Step 706). T1 represents the maximum time required to receive the broadcast message. If the user station correctly receives the broadcast message of the base station and obtains the UL-RACH-MAP information in T1 time (Step 708), it can get the information of the allocated access channel group with the UL-RACH-MAP information, the user station may randomly select the access (sub) channel from the access channel group and send the access request message RNG-REQ or RNG-REQ-HO in the selected access (sub) channel, in which the format of RNG-REQ-HO is shown in Figure 5 (Step 712). After sending, the user station waits for the response message from the base station.

If the time for the user station to wait for the response message RNG-RSP from the base station is longer than T2 (Step 716), it continues to judge if the retransmission number is larger than a set value (Step 718), if yes, it indicates error and executes the error process (Step 720) ,in which, T2 is the maximum time to wait for response. If the retransmission number of Step 718 does not exceed the set value, then determine whether it exceeds the access process time that can be endured (Step 722), if it exceeds the endured access process time, it will executes the error processing (Step 720). If it determines that it does not exceed the endured process time of the service at the step 722, it will

select the backoff domain according to the priority level of the service (Step 724), that is, select the corresponding start and end value of the backoff, for example, if the hard handoff occurs, the user station can select the backoff domain according to the priority level of the hard handoff. After performing the step 724, the user station selects the backoff value from the selected backoff domain by the multi-level backoff algorithm (Step 726), and waits for the calculated backoff time (Step 728). When the backoff time expires, the user station sends the RNG-REQ or RNG-REQ-HO again at the specified access (sub) channel, goes to the step 714 and wait for the response message RNG-RSP.

If the user station receives the response message RNG-RSP from the base station during the time T2, it will adjust the local parameters (Step 732) according to the response message RNG-RSP and determines whether the user station has adjusted the local parameters correctly. If it has not correctly adjusted the parameters, then executes the error processing (Step 740). If it is determined that the user station has correctly adjusted the local parameters at the step 734, then it will send the access request message RNG-REQ or RNG-REQ-HO in the selected access (sub) channel again (Step 736). The RNG-REQ or RNG-REQ-HO contains the identifier allocated by the base station for this access request, which will indicate the base station that the user station has successfully receive the relevant information sent by the base station, and after that, proceeds the next phase (Step 738).

WHAT IS CLAIMED IS:

1. A method for providing multi-level access service in a common access channel comprising steps of:

announcing following information by a base station in a wireless network system to cells corresponding to the base station periodically or on-demand through a forward common control channel: (a) common access (sub)channel allocation information, and (b) division information of at least two backoff domains in at least one common access (sub)channel;

sending an access request response message which carry a unique connection identification CID assigned by the system to an access request to a user station after receiving an access request message from the user station correctly and confirming that it can provide a corresponding access service for the user station; and

(a) selecting a corresponding backoff domain according to an access type, and (b) calculating a time for re-initiating the access request by using a backoff algorithm in the corresponding backoff domain if it initiating the access request in the selected common access (sub)channel after the user station in the wireless network system correctly receives the information on the common access (sub)channel allocation announced by a serving cell and the division information for at least two backoff domains of at least one common access channel.

2. The method according to Claim 1, wherein the base station in the wireless network system announces the allocation information of each access (sub)channel periodically or on-demand through the forward common control channel.

3. The method according to Claim 1, wherein the base station in the wireless network system announces the division information for at least two backoff domains corresponding to at least one common access (sub)channel in the forward common control channel periodically or on-demand.

4. The method according to Claim 1, wherein after the user station in the wireless network system correctly receives the information on the common access (sub-) channel allocation and the division information for at least two backoff domains of at least one common access channel announced in the serving cell, if it initiates the access request, it will randomly select a backoff value in the corresponding backoff domain with the backoff algorithm to determine the time for re-initiating access request in selected common access (sub)channel.

5. The method according to Claim 1, wherein the network access request identifying handoff including steps of:

initiating the access request message to the base station by the user station during the handoff processing, the network access request message for the handoff including the field that identifing the handoff request type; and

sending the access request response message to the user station by the base station after correctly receiving the access request message from the user station and confirming that it can provide corresponding access service for the user station, the message carrying the unique connection identification CID assigned by the system to the access request.

6. The method according to Claim 5, wherein said network access request message for the handoff is obtained by adding the field that identifying the handoff request type to an original access request message.

7. The method according to Claim 5, wherein said network access request message for the handoff is the access request message that using dedicated pseudo-random codes information.

8. The method according to Claim 5, wherein when the user station initiates the access request message to the base station, the network access request message for the handoff uses the dedicated access request message RNG-REQ-HO, the RNG-REQ-HO at least including fields that identifying the uplink access (sub)channel deployed and that identifying the access type used for the handoff.

9. The method according to Claim 5, wherein when the user station initiates the access request message to the base station, the network access request message for the handoff is obtained by adding at least the fields that identify the uplink access (sub)channel deployed and that identify the handoff request type to the original access request message RNG-REQ.

10. The method according to Claim 5, wherein in IEEE802.16e specification, the generation and allocation method for the pseudo-random codes used by the system to identify the network access request during the handoff including steps of:

generating the pseudo-random codes used by the system to identify the network access request for the hard-handoff by punctuating the long code which is outputted by the generation equation of searching code under OFDMA mode in IEEE802.16a, the punctuated pseudo-random codes eventually being different from those used for other purpose to make the system identify easily; and

(a) allocating the pseudo-random codes used by the system to identify network access request for the hard-handoff by the system to each cell permanently , or (b) allocating the pseudo-random codes used by the system to identify network access request for the hard-handoff by the system to each cell dynamically according to each cell's demand.

11. The method according to Claim 10, wherein the pseudo-random codes used by the system to identify network access request for the hard-handoff is generated by punctuating the long code, which is outputted by the generation equation $1+X^1+X^4+X^7+X^{15}$ of the searching code under the OFDMA mode in the IEEE802.16a.

12. The method according to Claim 10, wherein the pseudo-random codes used by the system to identify network access request for the hard-handoff is generated by punctuating the long code, which is outputted by the generation equation $1+X^1+X^4+X^7+X^{15}$ of the searching code under the OFDMA mode in the IEEE802.16a, the clock used to punctuate the pseudo-random codes is different from those used to punctuate pseudo-random codes for other purpose, which making the punctuated pseudo-random codes dissimilar eventually so that the system is easy to identify.

13. The method according to Claim 10, wherein said generation of the H pseudo-random codes required by the access request for the handoff includes steps of: generating H pseudo-random codes by punctuating the long codes that are outputted by generation equation $1+X^1+X^4+X^7+X^{15}$ of the searching code under the OFDMA mode, and the set constructed by the generation clocks of these H pseudo-random codes has no intersection with other sets composed of generation clocks of the pseudo-random codes used for other purpose.

14. The method according to Claim 13, wherein the following sets are obtained by punctuating the long code: the beginning N codes punctuated being a set A; the succeeding M codes being a set B; the succeeding L codes being a set C; and the succeeding H codes being a set D, the pseudo-random codes used for an initial searching, a periodical searching, a bandwidth request and an

access request function for the hard-handoff select one set respectively as a set for respective pseudo-random code.

15. The method according to Claim 14, wherein for the beginning N codes (corresponding to the set A) punctuated from the long code are used for the initial searching, according to the output of this generation equation, the clock is selected from 0 to 106 * (N)-1; the succeeding M codes (corresponding to the set B) are used for the periodical searching, the clock is selected from 106*N to 106*(N+M)-1; the succeeding L codes (corresponding to the set C) are used for the bandwidth request, the clock is selected from 106 *(N+M) to 106*(N+M+L)-1; the succeeding H codes (corresponding to the set D) are used for access request function for the hard-handoff, the clock is selected from 106* (N+M+L) to 106 * (N+M+L+H)-1.

16. The method according to Claim 10, wherein the pseudo-random codes used by the system to identify the network access request for the handoff can be permanently allocated by the system to each cell.

17. The method according to Claim 10, wherein further including steps of:

(a) sending the identifier of the pseudo-random codes allocated to the cell or other identification information by each cell to the cell periodically or on-demand through the forward common control channel; and

obtaining the pseudo-random codes information allocated to the cell where the new selected base station locating by the user station by detecting the common control channel.

18. The method according to Claim 17, wherein the pseudo-random codes used by the system to identify the network access request for the handoff is dynamically allocated by the system to each cell according to each cell's demand, and each cell can send the identifier of the pseudo-random codes allocated to the cell or other identification information to the cell periodically or on-demand through the forward common control channel.

19. The method according to Claim 17, wherein the user station obtains the pseudo-random codes information allocated to the cell where the new selected base station locates by detecting the common control channel.

ABSTRACT OF THE DISCLOSURE

The base station in the wireless network system announces following information to its corresponding cells periodically or on-demand through the forward common control channel: the common access (sub)channel allocation information, and the division information of at least two backoff domains in at least one common access (sub)channel; after correctly receiving the access request message from the user station and confirming that it can provide the corresponding access service for the user station, the base station sends the access request response message to the user station. This message will carry the unique connection identification CID assigned by the system to the access request; after the user station in the wireless network system correctly receives the information on the common access (sub)channel allocation announced by the serving cell and the division information for at least two backoff domains of at least one common access channel, if it initiates the access request in the selected common access (sub)channel, it will select the corresponding backoff domain according to the access type, and calculate the time for re-initiating access request by using the backoff algorithm in the corresponding backoff domain.

Figure 1 is an illustration for the forward and reverse channel;

Figure 2a is an illustration 1 for frame control information and channel mapping for TDD mode;

Figure 2b is an illustration 2 for the frame control information and channel mapping for TDD mode;

Figure 3a is an illustration 1 for the frame control information and channel mapping for FDD mode;

Figure 3b is an illustration 2 for the frame control information and channel mapping for FDD mode;

Figure 4.1 is a diagram showing the uplink access channel mapping (UL-RACH-MAP) format 1 that provides multiple backoff domains;

Figure 4.2 is a diagram showing the uplink access channel mapping (UL-RACH-MAP) format 2 that provides multiple backoff domains;

Figure 5 is a diagram showing the format of an access request message RNG-REQ-HO used for the handoff;

Figure 6a is a diagram showing the ranging process when the hard-handoff happens;

Figure 6b is a diagram showing the ranging process when the hard-handoff happens for the OFDMA mode; and

Figure 7 is a flowchart showing the access request of the user station.

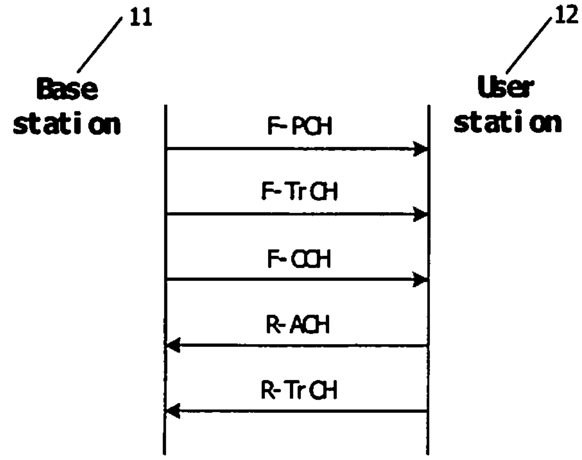

figure 1

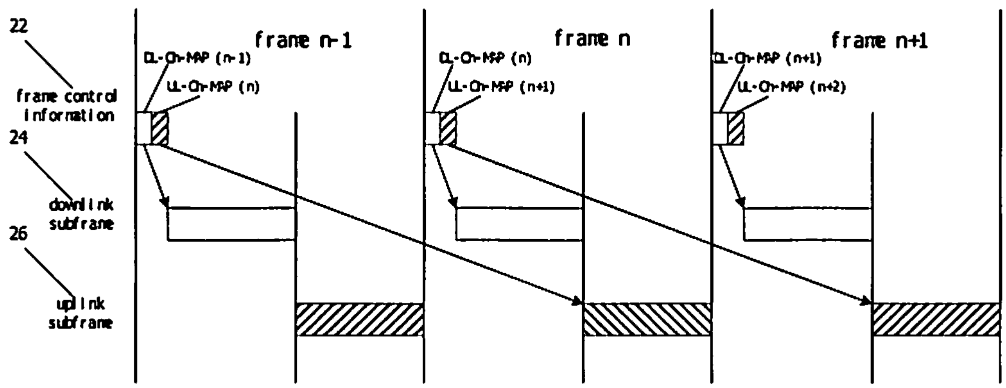

figure 2a.

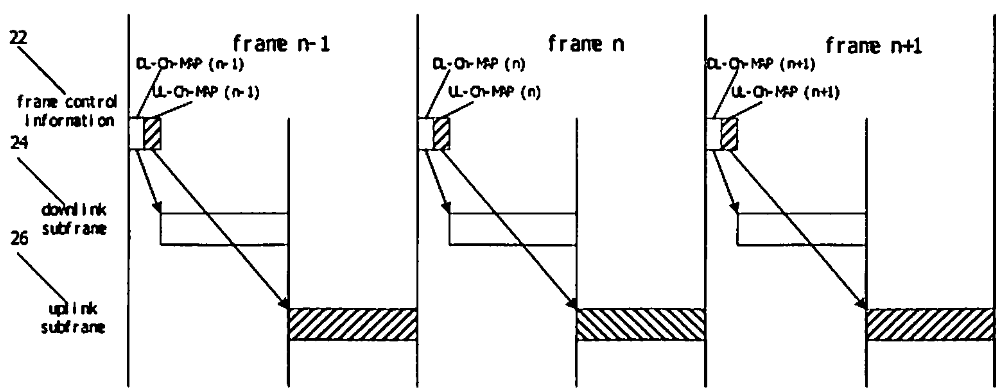

Figure 2b.

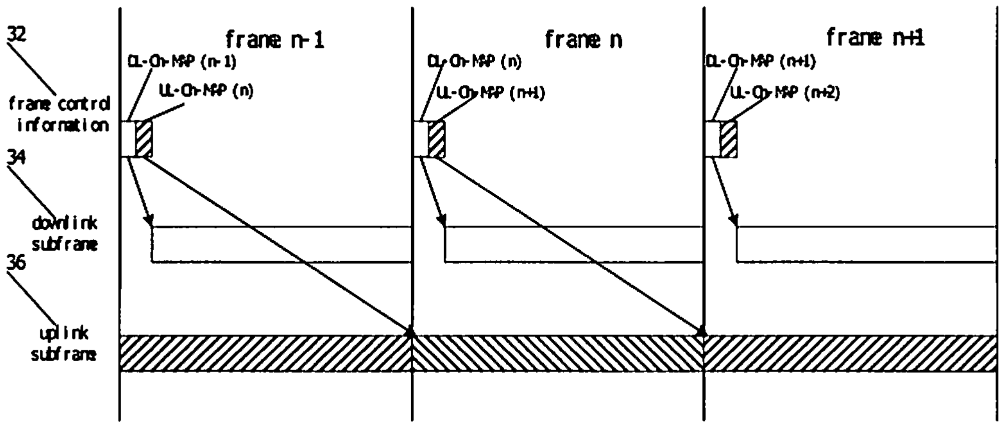

Figure 3a.

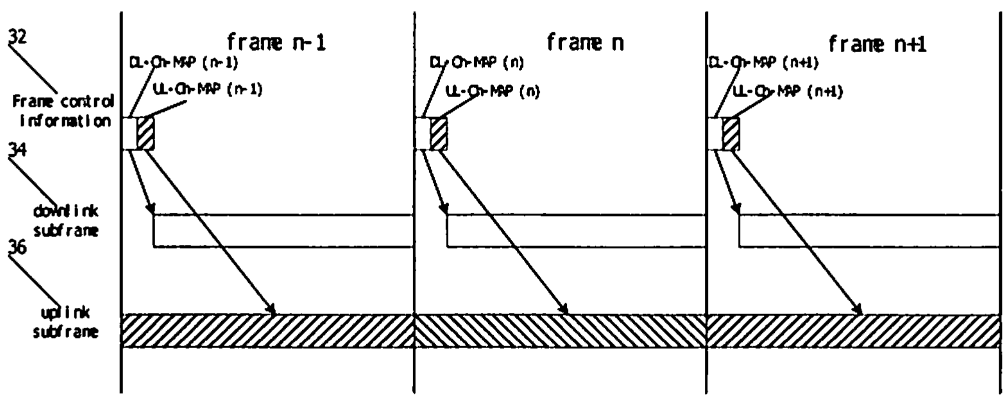

Figure 3b.

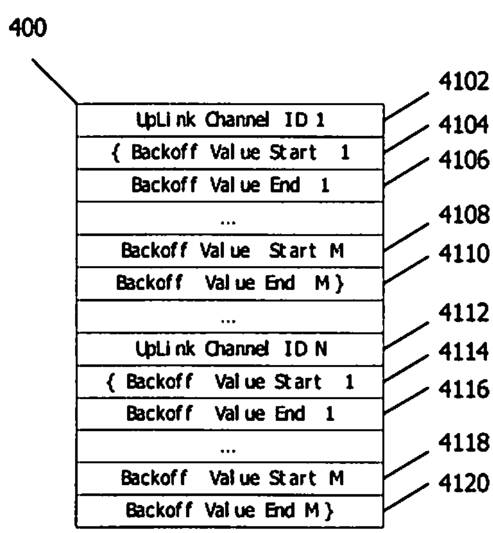

figure4.1

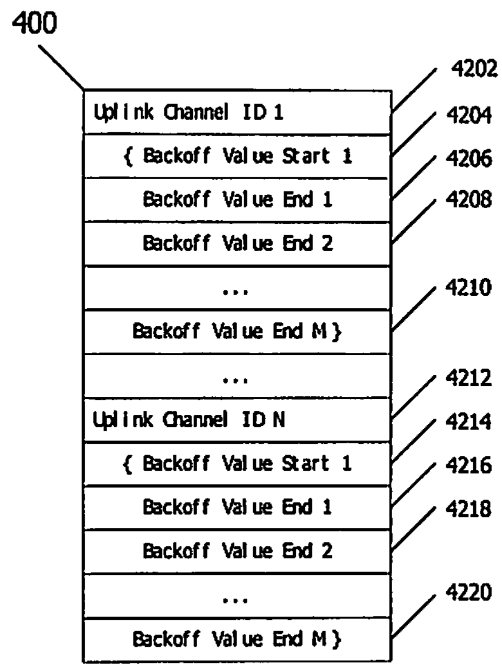

figure 4.2

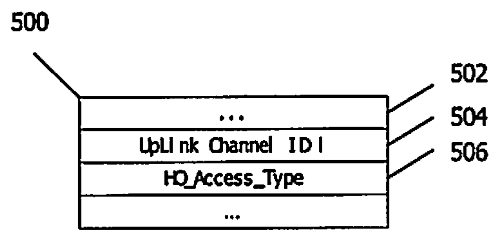

figure 5

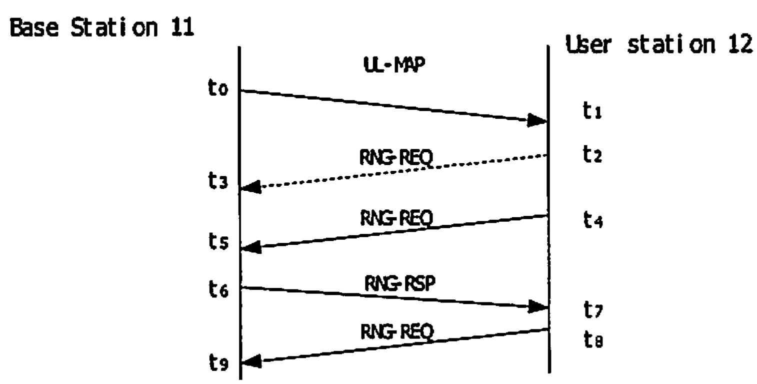

Figure 6a.

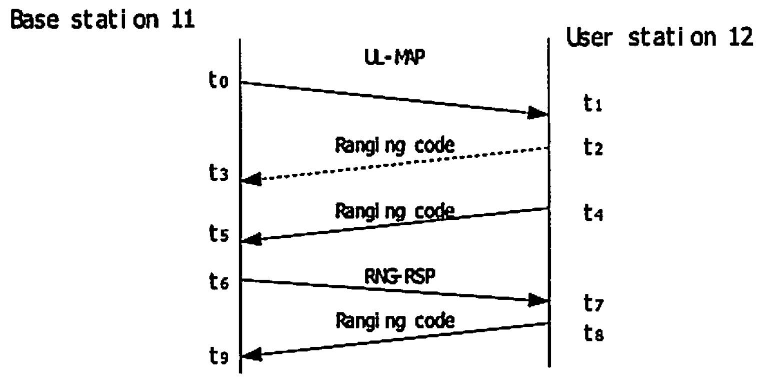

Figure 6b.

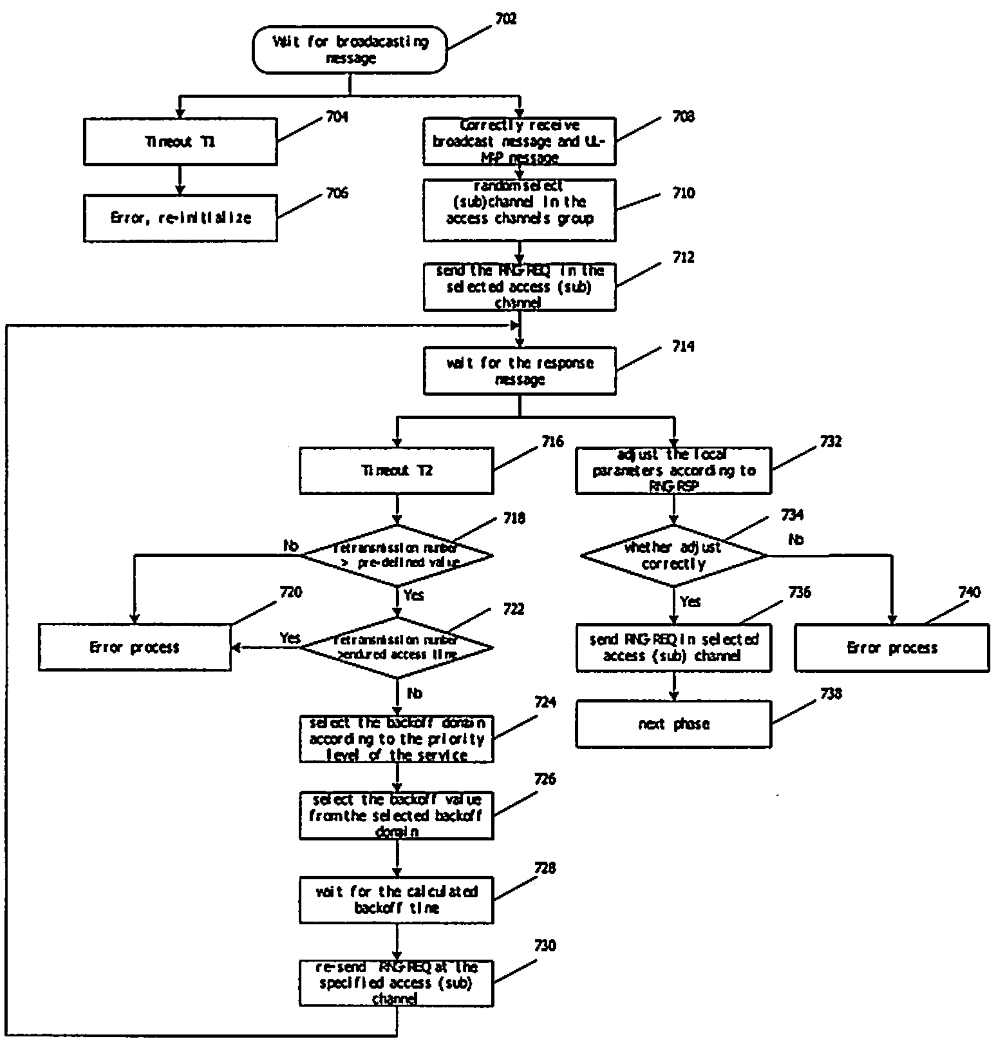

Figure 7.